

**ELK HILLS POWER PROJECT
RESPONSES TO
CALIFORNIA ENERGY COMMISSION
DATA REQUESTS #45-79
(through August 24, 1999)
(99-AFC-1)**

Submitted to:

**California Energy Commission
Sacramento, California**

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The groundwater areas that have been studied at the Elk Hills Oil and Gas Field are the south and north flank areas. South flank studies have been completed because the Tulare aquifer in this area is used as a disposal zone for produced water associated with past and current oil and gas operations. Produced water that is generated during oil recovery is injected into the Tulare Formation using underground injection wells permitted (Underground Injection Control (UIC) permit) by California Division of Oil, Gas, and Geothermal Resources (DOGGR). Studies of the north flank of the Elk Hills have been completed because of the proximity of the Kern Fan Element of the proposed Kern Water Bank to the northeast. To the north of Elk Hills, Faults 2 and 3 of the "Main Body B" structure form groundwater barriers, and other faults (including the Tupman Fault) may also behave like barriers (Milliken, 1993). In the south flank of Elk Hills, the Tulare clay forms a barrier to groundwater migration between the Tulare Formation and alluvium. A geologic cross section showing the relationship of the Tulare formation, the Tulare clay, and the alluvium is provided in Figure 5.4-5.

Phillips (1992) and Milliken (1992) have evaluated water quality and resistivity data (a measure of permeability), which indicates that the Amnicola clay acts as an aquiclude (impermeable barrier) separating the Tulare Formation groundwater from shallow aquifers above the clay layer. Therefore, the alluvium of Buena Vista Valley, from which agriculture irrigation water is obtained, is geohydrologically isolated from the Tulare Formation groundwater beneath the Elk Hills Oil and Gas Field.

Local Groundwater Quality

Portions of the Tulare Formation beneath the Elk Hills Oil and Gas Field have been designated as an exempt aquifer by California Division of Oil, Gas and Geothermal Resources (DOGGR) because it is hydrocarbon-producing (DOE, 1997). The maximum zone exemption includes the current productive limits of the field as set by DOGGR. The exempted portion of the aquifer coincides with the Elk Hills Oil and Gas Field boundaries except in a few areas. The limit of the aquifer exemption is shown in the geologic cross section (Figure 5.4-5).

The injection of produced water into exempt portions of the Tulare Formation at the Elk Hills Oil and Gas Field has been occurring since 1981 (BPOI et al., 1995). During the period 1982-1992, between 60,000 to 100,000 barrels per day (BPD) of produced water were injected into 11 wells penetrating this formation. The location of the produced water disposal wells is shown in Figure 5.4-6.

Since 1979, several wells have been completed in the Tulare Formation to supply water for enhanced oil recovery. There are five active source wells, and average daily source water withdrawal for Fiscal Year 1992 was 142,000 BPD (BPOI, 1992). Water quality from these wells ranges from 4,482 to 6,142 ppm TDS (BPOI et al., 1995). The locations of source water wells at Elk Hills are shown in Figure 5.4-6. The source wells are screened so that a majority of the groundwater is withdrawn from the Tulare Formation located between the Tulare clay